

The reptile fauna of the Soqotra archipelago

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Abstract: During a four-week faunal survey of Soqotra and its smaller satellites Semha and Abd El Kuri, as part of the UNDP/GEF project 'Conservation and Sustainable Use of the Biodiversity of Soqotra Archipelago', most of the resident reptile species were collected, including at least 4 undescribed taxa.

The vertebrate fauna of Soqotra is dominated by lizards, especially geckos, this family making up two-thirds of the approximately 30 reptile species, 27 of them being endemic. On Semha and Abd El Kuri, local endemic gecko species occur. Three lizard genera and one snake genus are endemic to the archipelago. The predominant biogeographic affiliation of the Soqotran reptile fauna is Afrotropical.

Key words: Soqotra archipelago, herpetofauna, endemism

Introduction

The Soqotran archipelago in the northwestern Indian Ocean, politically part of the Republic of Yemen, consists of three inhabited and a number of uninhabited islands. Geologically, they comprise the peaks of a submarine ridge in continuation of the northern Somalian highlands. However sea depth between Cap Guardafui on the Horn of Africa and Abd El Kuri, the nearest island of the archipelago about 90 km to the east, is between 200 and 1000 m, thus beyond Pleistocene sea level changes. If the separation of these islands was associated with the tectonic processes that lead to the formation of the Gulf of Aden and the Red Sea, it could be dated, with some reservation, to the first half of the Tertiary (older than 30 million years b.p.; see Girdler 1984). Therefore there should have been both a basic continental (African) faunal stock as well as plenty of time for the considerable evolution of a specific island fauna.

The individual islands are geologically similar (mainly limestone plateaus with coastal strips of limited extension) but different in size, climate and vegetation.

Soqotra, the major island, has an area of approximately 3600 km² (3625 km² according to Wranik 1998a), mountain peaks (the central Haghier range reaches 1500 m and frequent fogs are present), abundant water and a rich savannah-like vegetation dominated by trees or shrubs of the genera *Croton*, *Boswellia*, *Adenium*, *Dendrosicyos*, *Euphorbia* and *Dracaena* (fig.1). The total flora of the archipelago amounts to at least 850 species, of which many are endemic (Miller & Bazara'a 1998). Abd El Kuri (162 km²) and Semha (45 km²) also reach heights of up to 800 m, but are considerably drier, with no permanent streams and a succulent flora largely devoid of trees except a few *Euphorbia* (fig.2). Traditional agriculture is based on livestock (Soqotra and Semha) and date plantations (mainly Soqotra).



Fig.1: Slope with *Dracaena* trees to the north of Kilisan, central eastern Soqatra. Habitat of *Haemodracon riebecki* and *Hemidactylus* sp. (description in preparation).

Until recently, the faunal exploration of the archipelago has scratched only the surface of the total fauna. After a number of expeditions at the end of the 19th and the beginning of the 20th centuries (Günther 1881, Peters 1882, Dixey et al. 1898, Forbes 1903, Steindachner 1903), the islands were ignored by zoological researchers. This was mainly due to geographical as well as political isolation. Only limited field work was possible during the time of southern Yemeni independence (Wranik et al. 1986). An overview of animal taxa known from Soqatra prior to our expedition was given by Wranik (1998a).

This report is based on a four-week stay on Soqatra, Semha and Abd El Kuri during the whole of February 1999, as participants of the UNDP/GEF project 'Conservation and Sustainable Use of the Biodiversity of Soqatra Archipelago', which aimed at compiling an inventory of fauna and flora of the archipelago in order to design a master plan for conservation (Joger et al. 1999).



Fig.2: *Euphorbia* tree in the interior of Semha.

Results and Discussion

Endemism and biogeographic relations

The vertebrate fauna of the Soqotran archipelago is dominated by reptiles and birds. All freshwater fishes found so far belong to introduced species or represent secondary invaders from the marine environment. Amphibians do not exist. This paucity of freshwater vertebrates may be attributed to a combination of varying aridity in the geological past and the ubiquitous presence of voracious freshwater crabs (Potamidae). Most wild mammal species have been introduced, such as mice (*Mus musculus*), rats (*Rattus rattus*), and civet cats (*Viverricula malaccensis*). However, the speculation of Wranik (1998a) that the Soqotran fauna originated "before mammals appeared on earth" must be strongly rejected. This would imply a separation in Triassic times (approximately 200 million years b.p.) – which is not in accordance with tectonic evidence. Possible candidates for endemic mammal taxa are bats (*Rhinopoma* sp.) and a shrew (*Suncus* sp.) which we found on Soqotra. The specimens are under study.

The avifauna of the Soqotra archipelago is comparatively well known and comprises 31 breeding species, of which 6 species and 10 or 11 subspecies are considered endemic (Al Sagheir & Porter 1998). This rather low number of endemics could have been expected in animals capable of flying, and is found to be similar in dragonflies (Schneider & Dumont 1998). In contrast, among approximately 30 reptile species present, only 3 geckos of the genus *Hemidactylus*

Soqotran Reptile Genera

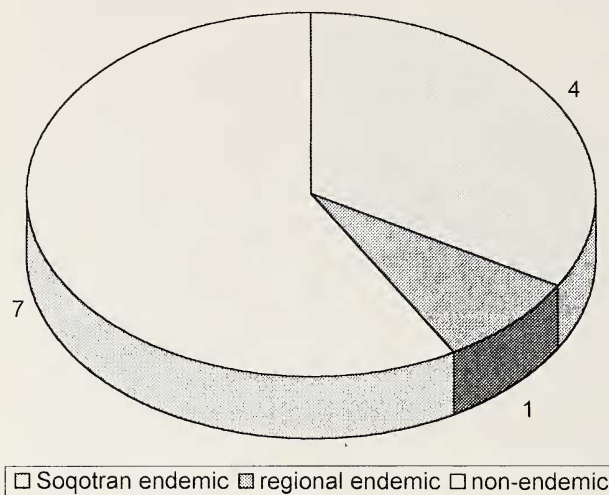


Fig.3: Genus level endemism in Soqotran reptiles.

(10%) also occur outside Soqatra and are likely to have been introduced by man. At least two of them (*Hemidactylus turcicus* and *H. flaviviridis*) frequently occur in and around human habitations. Thus the indigenous reptile fauna can be considered 100% endemic. Even one third of genera are endemic (fig.3), namely the gekkonid *Haemodracon* Bauer, Good & Branch, 1997, the scincid *Parachalcides* Boulenger, 1899, the trogonophid amphisbaenian *Pachycalamus* Günther, 1881 (fig.4), and the colubrid *Dityrophis* Günther, 1881 (fig.5). A regional or subendemic genus is the diurnal gekkonid *Pristurus*, which occurs in the countries bordering the Red Sea and the Gulf of Aden. Its sister genus appears to be *Quedenfeldtia* from southwestern Morocco, a relict area where a pre-Saharan fauna, including *Trogonophis*, a relative of *Pachycalamus*, occurs¹. *Haemodracon* may be part of



Fig.4: *Pachycalamus brevis*, the endemic Soqotran amphisbaenid.

¹ The remaining genera of the Trogonophidae are *Diplometopon* from eastern Arabia and *Agamodon* from Yemen and Somalia.



Fig.5: *Dityophis vivax*, one of the two endemic Soqotran colubrids.

an Afro-Malgasian group of leaf-toed geckos (Bauer et al. 1997). *Dityophis* was considered related to the Afro-Malgasian genera *Pythonodipsas*, *Geodipsas* or *Dipsadoboa* (= *Thamnodynastes*) (Günther 1881, Bogert 1940, Parker 1949). *Parachalcides* resembles the South African genus *Sepsina* (Boulenger 1903). Although the real evolutionary relationships of these genera will be analyzed using molecular techniques, it can be stated that the fauna is of predominantly Afro-Malgasian or Afro-Arabian (pre-Saharan) origin, and the disjunct distribution of groups and the high diversification point to an ancient separation of these taxa (Joger 1987).

Among endemic species of non-endemic genera, the Soqotran chameleon (*Chamaeleo monachus* Gray, 1864) clearly belongs to the mainland African/west Asian genus and subgenus *Chamaeleo* s.str., not to the Malgasian radiation (Klaver & Böhme 1986). Its type locality "Madagascar" must therefore be erroneous, and Wranik's (1998a) consideration that it might have been imported by man is also contradicted by the fact that it does not occur elsewhere.

The endemic nocturnal geckos of the genus *Hemidactylus* are rather diverse, but most of them resemble one or the other Somalian species. Somalia can be considered an area of primary radiation of the genus (Joger 1985). It should be noted that Abd El Kuri, the island closest to Somalia, harbours two *Hemidactylus* species of its own (*H. forbesii* Boulenger, 1899 and *H. oxyrhinus* Boulenger, 1899).

The scincid *Mabuya socotrana* (Peters, 1881) also appears related to African congeners. The lacertid lizard *Mesalina balfouri* (Blanford, 1881) is similar to *M. guttulata*, a Saharo-Sindian species (Boulenger 1903). The colubrid snake *Coluber socotrae* (Günther, 1881) is probably allied to the Afro-Arabian *C. florulentus* group (Parker 1949).

Little can be said about the affiliations of the three blind snakes of Soqotra: *Leptotyphlops filiformis* (Boulenger, 1899), *L. macrura* (Boulenger, 1899), and *Typhlops socotranus* Boulenger, 1889. The former is similar to the Saharo-Arabian *L. macrorhynchus*, the latter has been considered a relative of *T. cuneirostris* from Somalia (Parker 1949).

Missing families and genera; erroneous records

Land tortoises were mentioned in a Greek report from the 1st century A.D. on “Dioscurida” - an island later identified as Soqotra (Schoff 1912, from Schneider 1996). Today only sea turtles nest on the archipelago. Taking into account that large tortoises used to live on many Indian Ocean islands such as the Seychelles, Aldabra, Madagascar and the Mascarenes, where they were eradicated by sailors, settlers and introduced predators (Arnold 1981), there is some likelihood for this (although no tortoise bones or shells have been found so far on Soqotra).

As the same report also mentions large lizards, Wranik (1998a, b) speculates about the occurrence of a now extinct *Varanus*. However this is unlikely. Contrary to land tortoises, varanids have never been reported from other western Indian Ocean islands. Instead, large scincids and gekkonids are known from some of them (Arnold 2000, this volume). The explanation for their absence is that varanids originated in southeast Asia or Australia (where they still have their greatest diversity) and invaded Africa and Arabia only during the Miocene (18-20 million years b.p.), when the Tethys' Sea had been interrupted by tectonic upheavals associated with the collision of the Afro-Arabian plate with continental Asia. The few *Varanus* species living in Africa and Arabia today have been found to be closely related to each other (Böhme et al. 1989) and can therefore be regarded as descendants of a rather recent invader – after Soqotra had been separated from the African continent.

A similar biogeographical history can be assumed for the Agamidae – a family present everywhere in Australia, Asia and Africa, except on Madagascar and the islands of the western Indian Ocean. On Madagascar their ecological niches are occupied by the otherwise New World iguanids. A fossil iguanid has been reported from Aldabra (Arnold 1981). Joger (1986, 1991) reconstructed the phylogeny of the two agamid subfamilies, Agaminae and Uromastycinae, and found that in both, Arabian and African radiations are much more recent than Oriental ones. They also reached East Africa after the separation of Soqotra. A record of *Uromastyx ocellatus* from Soqotra (Peters 1882) can be regarded as a locality error, since a chameleon from mainland Yemen (*Chamaeleo calypttratus*) was recorded from Soqotra in the same article.

Among the Gekkonidae, two names have been deleted from the faunal list of Soqotra. *Ptyodactylus sokotranus* Steindachner, 1902, described from Soqotra, was later found to be a synonym of *Phyllodactylus* (= *Haemodracon*) *riebecki* (Eiselt 1962), a fact that was overlooked by Wermuth (1965). The Soqotran population of *Pristurus rupestris*, a mainland gecko recorded from Soqotra by Peters (1882) and Boulenger (1903), was later described as *P. sokotranus* Parker, 1938.

The saw-scaled viper *Echis coloratus* was recorded from Soqotra by Balfour (Günther 1881) and controversially discussed by Parker (1949), Corkill & Cochrane (1965), Joger (1984) and Wranik (1998a, under the wrong name *Echinus coloratus*). During our survey, large black snakes resembling a cobra (*Naja* sp.) were observed at higher altitudes on Soqotra and Semha, but not caught. Although *Echis* and *Naja* are of African origin (Joger 1987) and thus possible original inhabitants of Soqotra, there are no records of venomous snakes or fatal snake bites among the human population.

Echis coloratus, like *Chamaeleo calytratus* and *Uromastix ocellatus*, occurs in Yemen and its Soqotran record can be attributed to a locality error, while the black snakes are most likely old melanistic individuals of *Coluber socotrae*.

Comparison between individual islands

Table 1 and fig.6 show that the herpetofauna of the smaller islands is much poorer than that of Soqatra. This is due to the well-known influence of both island size and habitat diversity on species numbers. Species of high altitude and a humid climate, such as *Parachalcides* and certain *Hemidactylus*, as well as arboreal *Pristurus*, are unlikely to occur on the arid satellite islands. However it should be noted that the fauna of the lesser islands has not been sufficiently explored. During a two-day

Table 1: Terrestrial reptile species known from the three main islands of the Soqotran archipelago. Non-endemic (probably allochthonous) species are denoted by an asterisk (*).

Soqotra	Semha	Abd el Kuri
Gekkonidae		
<i>Haemodracon riebecki</i> (Peters)	<i>Haemodracon</i> sp. (Joger, in prep.)	
<i>H. trachyrhinus</i> (Boulenger)		
<i>Hemidactylus flaviviridis</i> Rüppell*		<i>Hemidactylus forbesii</i> Boulenger
<i>H. granti</i> Boulenger		
<i>H. homoeolepis</i> Blanford	<i>Hemidactylus</i> , cf. <i>homoeolepis</i>	<i>H. oxyrhinus</i> Boulenger
<i>H. pumilio</i> Boulenger		
<i>H. turcicus</i> Linnaeus*		
<i>H. sp.</i> (Joger, in prep.)		
<i>Pristurus abdelkuri</i> Arnold*		<i>Pristurus abdelkuri</i> Arnold
<i>P. guichardi</i> Arnold	<i>Pristurus</i> sp. (Rösler & Wranik, in press)	
<i>P. insignis</i> Blanford		
<i>P. insignoides</i> Arnold		
<i>P. sokotranus</i> Parker		
<i>P. sp.</i> (Rösler & Wranik, in press)		
Chamaeleonidae		
<i>Chamaeleo monachus</i> Gray		
Lacertidae		
<i>Mesalina balfouri</i> (Blanford)	<i>Mesalina</i> cf. <i>balfouri</i>	<i>Mesalina</i> cf. <i>balfouri</i>
Scincidae		
<i>Mabuya socotrana</i> (Peters)	<i>Mabuya</i> cf. <i>socotrana</i>	<i>Mabuya</i> cf. <i>socotrana</i>
<i>Parachalcides sokotranus</i> Boulenger		
Trogonophidae		
<i>Pachycalamus brevis</i> Günther		
Leptotyphlopidae		
<i>Leptotyphlops filiformis</i> (Boulenger)		
<i>L. macrura</i> (Boulenger)		
Typhlopidae		
<i>Typhlops socotranus</i> Boulenger		
Colubridae		
<i>Coluber socotrae</i> (Günther)	<i>Coluber</i> cf. <i>socotrae</i>	
<i>Ditypophis vivax</i> Günther		

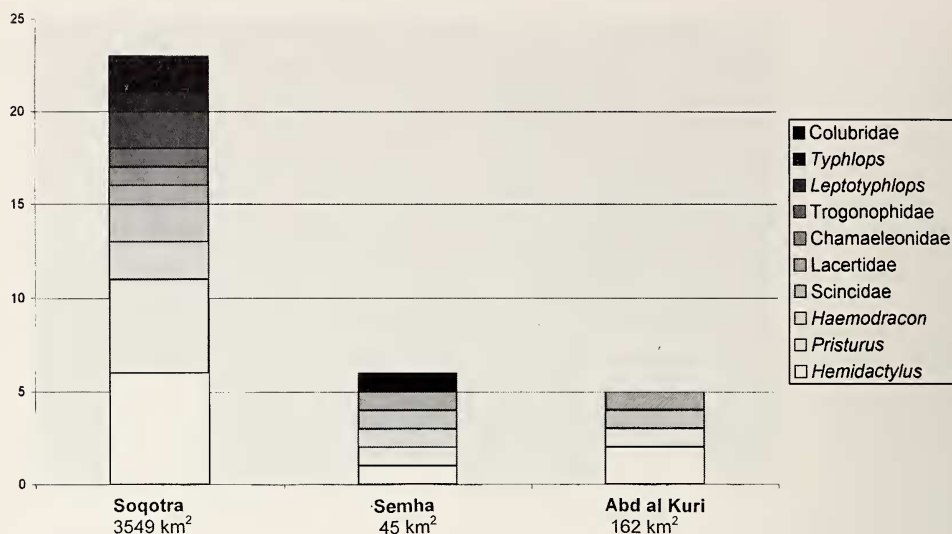


Fig. 6: Comparison of the reptile fauna of the three main islands of the Soqotran archipelago

stay on Semha, we discovered a new *Haemodracon* (fig.7) and a new *Pristurus* (fig. 8), and further taxa may have escaped our attention. For instance, the wormlike underground reptiles *Pachycalamus*, *Typhlops* and *Leptotyphlops* cannot be excluded. Other taxa, such as the *Mesalina* and *Coluber* of Semha, appear slightly different from their Soqotran congeners. Molecular investigations have been initiated to find out whether speciation has already occurred in these genera.

The reptile fauna of Abd El Kuri, the westernmost and most arid island, appears even more reduced in number of species, although its size is much larger than Semha. Nevertheless it contains three locally endemic gecko species, indicating an independent evolution as a result of long geographical isolation. Sea depth between Abd El Kuri and the other islands is more than 200 m, making any Pleistocene land connection unlikely (whereas Semha could have been connected to Soqatra via the smaller islet Darsa during times of lowest sea level).



Fig.7: *Haemodracon* sp., a new species (Joger, submitted) of leaf-toed gecko from Semha.



Fig.8: *Pristurus* sp. from Semha, described as a new species (Rösler & Wranik, submitted)

So far, no snake species have been collected on Abd El Kuri. However, we could only explore a small part of that island, and its faunal list may be not complete.

Radiations within the archipelago

Two-thirds of the reptile species of the Soqatra archipelago are geckos. Of them, two genera have undergone major radiations and multiple speciations:

- A diurnal radiation is represented by the genus *Pristurus*. The definite number of species and subspecies in the archipelago has yet to be determined, but there are at least five endemic taxa on Soqatra and one each on Semha and Abd El Kuri². Niche separation between them is mainly achieved by different microhabitats: one species is more or less ground dwelling (*P. socotranus*), two are saxicolous (*P. insignis* complex), and two are arboreal (*P. guichardi* complex).
- A nocturnal radiation is made up of *Hemidactylus* species. At least six species (three of them introduced) occur on Soqatra, one on Semha, and two on Abd El Kuri. Two Soqotran species (one of them new) are confined to the highlands. All live on rocks, but sympatric species are distinguished by size difference, so apparently occupying different food niches. A similar situation is found in the likewise nocturnal *Haemodracon*, a genus of which two species (*H. riebecki* on Soqatra and *H. sp.*, fig.7, on Semha) exceed sympatric *Hemidactylus* in size, whereas a third one (*H. trachyrhinus* on Soqatra) is very small (Rösler & Wranik).

Exploring speciation within these species complexes is an important task for future research.

²) *Pristurus abdelkuri* also occurs as an introduced population in coastal areas of Soqatra.



Fig. 9: One of many dead Green turtles (*Chelonia mydas*) near a fishermen's landing point on Abd El Kuri. Also habitat of *Hemidactylus forbesii*.

Conservation

The only reptiles that are threatened by direct human exploitation are sea turtles, which are caught by fishermen off the coast and probably also on their nesting beaches (fig.9). They are locally consumed and therefore their protection by CITES is not effective on Soqatra. Wranik (1998a) expresses concern that *Chamaeleo monachus* might be threatened by collecting for pet keepers. This fear is, however, not justified, as chameleon trade is controlled by CITES, and commercial pet traders have more accessible places elsewhere to supply themselves with chameleons. Moreover, the species is widespread and abundant on the island but difficult to find, due to its effective camouflage.

There is, however, an increasing pressure on reptile habitats by construction and development projects. Most reptiles occur in abundant numbers, but the large leaf-toed geckos of the genus *Haemodracon* appear to be less numerous and more vulnerable than other species. They lead a more or less sessile life in Dragon blood trees (*Dracaena cinnabari*) and Date palms (*Phoenix dactylifera*), but only old large trees with holes appear suitable. Tree cutting could adversely affect their populations. However they were also seen on vertical rocks with crevices. The population of the new species on Semha appears especially endangered due to its small total population size. Other potentially threatened species are those restricted to special biotopes, such as mangrove forests (*Pristurus* sp., fig.10) and higher altitude habitats (some *Hemidactylus* species, *Parachalcides socotranus*).



Fig.10: A mangrove-dwelling *Pristurus*, described as a new species (Rösler & Wranik, submitted).

An additional danger, the devastating effect of which is known from many island faunas, is introduction of foreign species. The Soqotran capital, Hadibo, is already devoid of indigenous *Hemidactylus* due to the presence of introduced *H. flaviviridis* and *H. turcicus* which have apparently outcompeted the original species. Introduced rats (*Rattus rattus*) are also very abundant at Hadibo. At present there are no dogs on the island, but if there were as many wild dogs as in mainland Yemen they would present a threat to the colubrid snakes. Cats are already abundant on Soqotra.

Conclusions

The current reptile fauna of the Soqotran archipelago is unique and results from a long evolutionary diversification of an ancient African or Afro-Arabian stock. Future studies should aim at the reconstruction of the phylogenies of these and other groups of Soqotran organisms.

A comparative estimation of genetic distances from mainland Arabian, African and Socotran taxa of several genera is in preparation. Such investigations promise to provide insights into the process of speciation, as well as into an understanding of the evolutionary and biogeographic history of East Africa, Arabia and the western Indian Ocean.

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